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CONTENTS

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METHODS OF SECURING BETTER COOPERATION BETWEEN GOVERNMENT AND LABORATORY ZOOLOGISTS IN THE SOLUTION OF PROBLEMS OF GENERAL OR NATIONAL IMPORTANCE[1]

THE Zoological Division of the Bureau of Animal Industry of the Department of Agriculture is particularly concerned with that branch of zoology commonly known as parasitology. The Animal Husbandry Division of that Bureau has a special interest in genetics, but as this is a subject that is receiving a good deal of attention from university zoologists at the present time the opportunities for cooperation with respect to the zoological work of the Animal Husbandry Division are perhaps better than they are with respect to the work of the Zoological Division. In any case it is not my purpose to consider the question of cooperation on problems in the field of genetics and my remarks on this occasion are made with reference to the possibility of securing closer cooperation between universities and the Department of Agriculture in research work in the field of parasitology.

The work of the Zoological Division consists chiefly in the investigation of the parasites of domestic animals and of those trans-

[1] A symposium before the American Society of Zoologists, held at Baltimore on December 26, 1918, Professor C. E. McClung presiding, included papers and discussions as follows: Representing the Bureau of Entomology, Dr. L. O. Howard. Discussion by J. G. Needham. Representing the Bureau of Fisheries, Dr. Hugh M. Smith. Discussion by Dr. H. B. Ward. Representing the Bureau of Animal Industry, Dr. B. H. Ransom. Discussion by Dr. Herbert Osborn. Representing the Bureau of Biological Survey, Dr. E. W. Nelson. Discussion by Dr. R. K. Nabours. Relation of the Council of National Defense and the National Research Council to the Advancement of Research, Dr. John C. Merriam.

missible from domestic animals to man with the purpose of establishing methods for their control and eradication. The welfare of the live-stock industry, the public health, and other large national interests are dependent in no small measure upon the suppression of diseases caused by animal parasites as well as those of bacterial origin. The results of scientific research in the field of parasitology have in repeated instances supplied the knowledge necessary to bring about the eradication or control of disease. Many problems in this field remain to be solved. From a practical standpoint therefore parasitology is a highly important branch of zoology. It has, however, not been popular among American zoologists and there are few universities in this country where graduate students have favorable opportunities for acquiring the working knowledge essential for the practical parasitologist. Parasitology of course is a very special branch of zoology and it is not to be expected nor is it desirable that a large number of specialists should be trained for research in parasitology, but I believe that the present and future needs of the country are sufficient to justify more attention to this subject by zoologists than has heretofore been given. The Zoological Division has always had difficulty in securing the services of properly qualified men to carry on its work. The neglect of parasitology by zoologists is no doubt largely responsible for this condition. Low salaries and other objectionable features of government service, real and imagined, may have contributed to the difficulty of maintaining our scientific staff. University professors however, and especially subordinates to the heads of departments of universities have not fared better with respect to salary than men in corresponding positions in scientific branches of the government service, and the red tape and other troubles that worry government scientists are no more disagreeable than some of the things endured by the scientific man in the university.

In the face of the evident fact that parasitology is a subject with which American zoologists have comparatively little to do at present, what are the possibilities of cooperation between the universities and the Bureau of Animal Industry with respect first to the training of parasitologists for government service and second to research in university laboratories on problems of parasitology likely to yield results of direct or indirect value to the work of the Bureau of Animal Industry in the suppression of parasitic diseases?

Although extensive cooperation can scarcely be undertaken under existing conditions it should nevertheless be possible to bring the universities and the Bureau of Animal Industry into closer contact with resultant benefit to both. It is hardly worth while at present to speculate upon the extent to which cooperation between the two may be developed in the future as it will necessarily be dependent upon the course of development of the general policy of cooperation in scientific work between the universities and the government. I shall therefore only venture a couple of suggestions as to what might be done immediately toward securing more effective cooperation than has existed in the past. These suggestions should be taken as suggestions only and not as the fixed policy of the Bureau and Department with which I am associated, although it may be stated that there is nothing particularly novel about them and I see no reason why they should be objectionable from a departmental standpoint. One plan that has occurred to me is essentially simple, namely, to give a limited number of graduate students specializing in parasitology the opportunity of studying in the laboratory of the Zoological Division for a limited period of time in each case. Much could not be promised in the way of personal instruction and such students therefore should have demonstrated their ability to work more or less independently. Ordinarily perhaps not more than one student at a time could be thus accommodated. It is likely that arrangements could be made for the payment of a salary in return for what service the individual was able to render the division during the time he spent in the laboratory, so that his laboratory experience need cost him nothing. A plan of

this kind would naturally involve some trouble from the standpoint of administration of the work of the division, but I believe the fact that it would give the chief of the division an opportunity to become acquainted with students of parasitology who might later desire to enter the service and thus enable him to form an opinion as to their capabilities and suitability for the work would offset any inconveniences resulting from their presence in the laboratory. The student himself would not only profit from what knowledge of parasitology he was able to gain during his stay in the laboratory, but he would also be able to determine better than he might otherwise whether he would care later to take a position in the division.

As to possibilities of cooperation between university departments of zoology and the Bureau of Animal Industry in research work on problems relating to parasitic diseases it would be quite feasible in some cases for the bureau within certain limits to assist financially or otherwise in investigations likely to yield results of value to the live-stock industry of the country. The exact nature of cooperative arrangements which might be made in any instance would depend largely upon the special conditions of the individual case, and nothing would be gained by discussing plans of cooperation at this time. Without going into details I may therefore limit myself to an expression of the willingness of the bureau to cooperate with university zoolgists in investigations in the field of parasitology in any way possible.

My remarks have been very brief but if the suggestions I have offered are of any value more elaborate discussion can be left for other occasions, if they are not the brevity of their presentation is not to be regretted. In any case I am very glad to have had this opportunity of speaking a word for practical zoology, of expressing the belief that it deserves more attention from the zoological profession in this country than it has hitherto received, and of pointing out certain ways by which it may be possible to bring about better cooperation between the universities and the government in zoological research.

B. H. RANSOM
BUREAU OF ANIMAL INDUSTRY

DR. RANSOM'S paper suggests several topics for discussion and is certainly opportune.

It is probably true that the subject of parasitology has been neglected in large measure in our colleges and universities but I can hardly agree that it is due to lack of interesting phases of the subject. No doubt tapeworms are less attractive than birds or butterflies, but when we take into account their remarkable adaptations and the complex adjustments involved in their alternations of host they offer most fascinating points for biologic study, and to this may be added their economic interest. In my own experience I have usually found that students respond very promptly to discussion of these aspects of parasitic biology.

As to the dearth of workers there is something to be said in the matter of demand. In my own experience I have often had students who became interested in the subject but the great majority of our university students have to meet the practical problem of entering on work that will bring them a living income and it has usually been the case that when this feature was met the man would find more attractive openings in teaching or research in other lines.

As to practical lines of cooperation I think Dr. Ransom has made a suggestion that is practicable and quite feasible. Advanced students and especially graduates working on theses or dissertations might very profitably be assigned for a specified time to work in the bureau laboratories or for field work, perhaps utilizing their summer vacations as is done in geology or entomology with perhaps joint supervision of bureau and university department so that there may be opportunity for university credits.

Courses in parasitology have been offered in a number of institutions especially in recent years but I am not posted as to the extent of enrollment. However, any figures for recent years would be of little value as showing drift to these courses. I believe some of the men

with this training have found place in government service along lines related to their specialty but how many I could not say.

Teachers may very profitably emphasize the features of parasitism that afford examples of biologic adaptation and in medical and agricultural applications and this should serve to aid in the application of the bureau results.

I believe a very useful aid in this work would be for the bureau to furnish to the laboratories, willing to cooperate, a condensed manual for the more essential technique in the preparation of material for study and keys for identification of species most commonly met with in laboratory work.

The laboratory guides of Braun & Lühe: Stitts; and Herms, and Pratt's indispensable "Manual of Invertebrates" are of course available and are no doubt very generally used but they are more likely to fit into special or advanced courses and a simple hand-book, in mimeograph form if desired, available for use in some of the more general courses would, I believe, help to stimulate interest.

Possibly an outline of a course in parasitology arranged by a conference between representatives of bureau and university teachers might help especially if such outline indicated what special problems could be worked to advantage in any particular locality. Also the employment of advanced students in the routine duty of collecting or preparing material for bureau use might be possible. A circular letter from the bureau to university departments suggesting work that might be done would be helpful, and I believe that suggestions to teachers as to the matter and form for best presenting to students and thereby to a larger public, the results of the bureau work might be of advantage.

Specific training of specialists for the bureau service might be facilitated by an understanding as to probable employment of men willing to enter the field as their life work.

I do not understand that the demand is wide enough, for the immediate future at least, to warrant many schools making a specialty of the subject but certainly a few schools with proper facilities might very profitably offer distinct courses preparing for such work and prospective students in this line could then be steered to such schools from other departments not emphasizing this phase of zoology.

Another thing which, speaking from the university side, seems to me worth considering would be the preparation of a moderate number of representative species of parasites for demonstration purposes in classrooms or laboratories or even the accumulation of certain abundant forms sufficient for laboratory dissections or study. The bureau doubtless has a large accumulation of duplicate material from which it would be possible to supply material where desired with perhaps the agreement that the department so supplied should contribute other material as it might become available.

While it often happens that a quantity of specimens of some particular species is found in great abundance I believe we will all agree that the securing of such material in condition and quantity for laboratory purpose is more difficult than for most other groups.

Perhaps my suggestions may seem to be rather one-sided, involving mostly assistance from the bureau to the university laboratories, but I believe that the bureau will find the university men ready and willing to cooperate and that they will welcome definite suggestions as to ways and means by which such cooperation may be established.

Herbert Osborn
Ohio State University

THE THREATENED EXTINCTION OF THE BOX HUCKLEBERRY, GAYLUSSACIA BRACHYCERA

The box huckleberry (*Gaylussacia brachycera*) is a rare and beautiful American shrub which is in process of extinction. It is declared by Mr. Harlan P. Kelsey, the well-known landscape architect, of Salem, Massachusetts, that for many woodland situations it is the most beautiful native evergreen ground cover known to him. The biological problem is to preserve the wild plant from extinction and at the same time to bring it into horticultural use.

Two years ago the writer, desiring to ex-

amine the plant in its wild state, sought to find out its known localities by consulting the larger American herbaria. He was surprised to find specimens from only two localities, one in Perry County, Pennsylvania, the other in Sussex County, Delaware. The original locality assigned to the plant by Michaux in 1803, namely, near Winchester, Virginia, is almost certainly a mistake, and its occurrence at the localities in Bath County, Virginia, Greenbrier County, West Virginia, and Polk County, Tennessee, in which it is alleged to have been found, appears not to be substantiated by specimens in any American herbarium.

On July 13, 1918, under the guidance of Mr. Kelsey, the writer visited the Pennsylvania locality. The plant is confined to a single patch extending for a distance of over 400 yards along the slope and shoulder of a timbered west-facing hill. It occupies an area of about eight acres. The soil is a loam of buff-gray color, weathered from an underlying shale of similar color. It has no other supply of water than direct rainfall. Overlying the loam is a layer of upland peat a few inches in thickness, such as commonly characterizes an area of acid-soil dry-land vegetation.

The character of the vegetation is indicated by the following list of its commoner plants.

Trees:

Scarlet oak (*Quercus coccinea*),
White pine (*Pinus strobus*),
White oak (*Quercus alba*),
Chestnut (*Castanea dentata*),
Chestnut oak (*Quercus montana*),
Red maple (*Acer rubrum*),
Black gum (*Nyssa sylvatica*),
Dogwood (*Cornus florida*).

Shrubs:

Box huckleberry (*Gaylussacia brachycera*),
Laurel (*Kalmia latifolia*),
Wintergreen (*Gaultheria procumbens*),
Dry-land blueberry (*Vaccinium vacillans*),
Trailing arbutus (*Epigaea repens*),
Lowbush blueberry (*Vaccinium angustifolium*),
Juneberry (*Amelanchier canadensis*),
Pink azalea (*Azalea nudiflora*),
Sweet fern (*Comptonia peregrina*),
Pipsissewa (*Chimaphila umbellata*),
Spotted pipsissewa (*Chimaphila maculata*),
Witchhazel (*Hamamelis virginiana*).

There is no indication from the soil, moisture conditions, exposure or accompanying vegetation that there are any special conditions on this area, different from thousands of other areas in the Apalachian region, to explain the presence of the box huckleberry in this particular spot.

Over the whole area the root mat of the box huckleberry is practically continuous. Only one isolated piece was seen outside the main patch, and that was on a steep grassy slope immediately north of the main area, where farm cultivation had been begun but later abandoned. This plant is undoubtedly a piece of the original patch, cut off from the rest by the cultivation but left alive because the cultivation had been discontinued.

The abrupt termination of the patch, unaccompanied by any change in the soil, and the absence of isolated patches were most amazing. In the two hours we spent at the place we sought for the explanation, and I think we have it. But before it is outlined, let me present additional evidence of the completeness of the plant's isolation. On the north and much of the east and west sides the patch is bordered by cultivated fields and a road. The natural extension of the patch in these directions is therefore impossible. On the south end, however, the present margin of the patch is located amid natural surroundings. It runs through the timber in a sinuous but definite line which coincides with no topographic or other natural barrier. All along this line the patch is actually progressing and extending by sending out rootstocks which throw up new stems at the end of each year's growth.

For a distance of 125 yards at the southern end of the west side of the patch, the mat ends abruptly at the bottom of the hill at a natural barrier, a slender woodland streamlet, so low at the time of our visit that in several places no water was flowing over its wet gravel bed. For much of the distance the brooklet has slightly undercut the hill, so that the edge of the root mat hangs suspended a few feet

above the water. At some points, however, the root mat comes down to the water's edge, but although suitable ericaceous soil occurs in many places on the other side of the brooklet, sometimes no more than three paces away, and other ericaceous plants occupy both banks, the box huckleberry has never jumped this tiny barrier.

The theory I advance is that the whole patch has spread by the root from a single plant. If this theory is correct the plant is undoubtedly more than a thousand years old. If it started in the middle of the present area and grew at an average rate of six inches a year, a liberal estimate judging from the observed length of its annual rootstock increment, its advance to its present front-line position would have required 1,200 years. The widely heralded but half legendary thousand-year-old rosebush of Hildesheim is easily outlived.

As additional evidence that the whole of the eight-acre patch consists of a single plant I may say that notwithstanding the most painstaking search we found no seedlings. Many small tufts were examined, but every one proved to be attached by a rootstock to an older piece. The base of the hill on which the patch occurs had been undercut for more than 250 yards by a public road. The steep bank between the road and the hill, formed many years ago in the grading of the road, furnishes at several points good germination beds for the seeds of the overhanging plants. In a careful search along the whole bank not a seedling of the box huckleberry was found, although the bank did bear seedlings of the closely related plants, laurel, dry-land blueberry and trailing arbutus.

The plant was in fruit at the time of our visit, the delicate light blue berries being particularly charming in their setting of dark green box-like foliage. A resident of the neighborhood told us that the plant fruited every year. Why then are there no seedlings?

I have recorded elsewhere, in an account of my blueberry breeding experiments, that individual blueberry plants, close relatives of the huckleberries, are partially or completely sterile to their own pollen. The seeds from such a pollination, if any are secured, are sterile, or if they germinate the seedlings are feeble and never develop into strong plants, even under the protecting care of cultivation. If this Pennsylvania box huckleberry patch consists of only one plant its seeds might be expected to be sterile or of feeble germination. And this in fact was found to be true. On examination about 90 per cent. of the seeds proved to be empty shells. Only about 10 per cent. contained endosperms. On November 20, 1918, 1,600 seeds were sowed in eight boxes in a suitable soil of peat and sand and subjected to different temperature treatments. From this sowing only three seeds germinated, and the three seedlings are feeble. From other sowings made on July 20, 1918, a somewhat better but still very poor germination was secured, and the largest of the plants, at the age of six months, are less than an inch high.

Further evidence that the whole patch consists of one plant is afforded by its botanical characters. With the exception of differences in size and vigor, due apparently to differences in the amount of nutrition, the plant is remarkably uniform over the whole area. This uniformity is particularly noticeable in the fruit, which has a curious obovoid-pyriform shape. While individual plants of other species of blueberries and huckleberries sometimes have this shape, a comparison of the fruit of many individuals of any species shows variation to other shapes, such as spherical, or even depressed. The uniformity in the form, and in the color also, of the berries throughout this patch is the same sort of uniformity that one finds in fruits that have been reproduced by cuttings, budding or grafting from a single parent plant.

On the theory that the perpetuation of the species through seeds could be brought about only by finding another plant, for cross pollination, an endeavor was made to relocate the Delaware station. Dr. C. S. Sargent informed me that in company with Mr. William M. Canby, the original discoverer, he had tried several years ago to find the spot, but without success, and he believed the plant had been exterminated. Nevertheless I sent a botanist

in November, 1918, to find the plant if possible, but after two days' search he was unable to locate it.

The situation had become acute, for a firm of nurserymen had taken away a truck load of plants from the Pennsylvania locality in 1918, and the doom of the species in a wild state appeared to be sealed unless we could find another plant, for the Pennsylvania plant was the only one actually known. Therefore when Mr. E. T. Wherry, the chemist, offered to make a further search for the Delaware area I gladly assented. To his acute insight into the soil habits of rare and fastidious plants he added further information that he found in Philadelphia regarding the location of the old Canby station, and after three days' systematic search, in early March of the present year, he found it.

From Mr. Wherry's report of his rediscovery the following paragraph is drawn:

This colony of the box huckleberry is situated on a northwest sloping bank about eight feet high. It covers an area but twenty feet square, the plant forming a practically pure stand in the center but thinning out rapidly in all directions. No seedlings could be found, all the stems apparently being connected with one another by running rootstocks so that really only a single plant is represented. A few stems extend into the wet, peaty material bordering the marsh but most of the colony is growing in dry, sandy upland peat made up of leaves of pine, oak and laurel, on the steep slope. The plants immediately associated, as far as could be determined at the time of the visit, are:

Trees:
- Pond pine (*Pinus serotina*),
- Red cedar (*Juniperus virginiana*),
- Red oak (*Quercus maxima*),
- Holly (*Ilex opaca*).

Shrubs:
- Inkberry (*Ilex glabra*),
- Laurel (*Kalmia latifolia*),
- Sweetbells (*Eubotrys racemosa*).

Vine:
- Greenbrier (*Smilax rotundifolia*).

Only five localities, widely distant, have been recorded for this plant and its existence in only two of these at the present time has actually been confirmed. The question why the species has become so nearly extinct has not yet been answered and perhaps never will be answered conclusively. I wish to call attention, however, to the probability that if these two northeastern patches consist of a single plant each, as it appears they do, it is likely that they were originally chance seedlings from seeds carried by birds beyond the original main range of the species. For if these patches were remnants of a former widespread continuous range, and climatic changes had destroyed the species over the rest of its range, each of these remnants would almost certainly have consisted of more than a single plant. I am impressed also by the possibility that a plant in process of extinction may have been killed over most of its original range by some particularly destructive fungus or insect, and that the reason of the preservation of healthy remnants may be that they were beyond the range of the destructive enemy. Possibly, too, the remnants were immune to the destroying agent. The present ravages of the chestnut blight (*Endothia parasitica*) give an idea of what may have happened to thousands of plant species now extinct or known only from distant remnants.

However, the box huckleberry is not extinct, and we are hoping for its rejuvenation through vigorous seedlings. In order that my colleagues may share in the excitement I may add that portions of the Pennsylvania and Delaware plants have been brought together at Washington, cross pollinations have been made, and fruit has set but is not yet ripe.

I trust I shall be pardoned if I add to this article an unessential postcript, the excuse for which is more biographical than biological. In April, 1846, Asa Gray, the most distinguished of American botanists, writing to his colleague, John Torrey, said:

> A Mr. Baird, of Carlisle, Pa., called on me yesterday, evidently a most keen naturalist (ornithology principally), but a man of more than common grasp. He talked about an evergreen-leaved Vaccinium, which I have no doubt is V. brachycerum, Mx., that I have so long sought in vain.!

This was the first meeting between Dr. Gray and Spencer F. Baird, second secretary of the Smithsonian Institution, who at that time, an ardent young naturalist of twenty-three, was professor of natural history at Dickinson College, Carlisle, Pa. The friendship thus begun between Gray and Baird was intimate and lifelong, lasting for more than forty years, and it had great constructive influence in the advancement of natural history in America. It was clearly Baird's discovery of the box huckleberry, the very same patch in Pennsylvania about which I have been writing, that chiefly drew the two men together at their first meeting, and since this charming little thousand-year-old lady of the forest has done so much for American naturalists, the least we can do in return is to try to keep her living forever.[1]

Frederick V. Coville

VINAL N. EDWARDS

Workers in science who are wont to visit Wood's Hole during the summer months will miss the familiar figure and kindly greeting of one who has been identified with every piece of faunistic work that has been carried on at the Fish Commission Laboratory since the time of Baird, and one whose wide range of activity, intimate knowledge absolute reliability and willingness to serve have made him a most valuable source of information and assistance to those connected with the "Marine Laboratory" since the time of its foundation. Vinal N. Edwards, in the continuous service of the government for over sixty years, died on April 5, 1919, and leaves vacant a place in the vital affairs of Wood's Hole that can not be filled.

If a young enthusiast felt that by early rising he might steal an advantage over other collaborators, his arrival at "the commission" found Vinal already hard at work. If a trip was made to the gulf stream, Vinal was the man that knew when, where and how to gain profit out of the expedition. If it were a quiet night, ideal for "skimming," it was Vinal's skiff that was moving silently among the slicks. Throughout the day, in the corridors of the laboratories, on the wharf or at the traps—it made no difference where—probably no sentence was more frequently heard than "I don't know, ask Vinal."

Untaught in the modern conception of the word, courteous in his manner, unmentioned in "Who's Who," unrecorded in "American Men of Science," here was a man remarkably well informed, courteous and friendly in his association with men, well known to a multitude of educators, and one upon whom many of the foremost workers in biological science relied for information and advice. It is probable that hundreds of new species have resulted from his activities as a collector. In Verrill's report on the invertebrates of Vineyard Sound, his name is repeatedly mentioned. Smith's paper on the fishes of the Wood's Hole region would have been impossible without his help, and those who were associated in the preparation and publication of the "Biological Survey of the Waters of Wood's Hole and Vicinity" frequently stated that one of the motives which originally prompted this work was the "desire to incorporate in a permanent form the valuable but unpublished data in the possession of this indefatigable collector and observer."

In order that the life and work of Vinal N. Edwards may not become forgotten, testimonials from several sources have been collected, and bound copies of these will be deposited in the Library of the United States Fish Commission, in the Library of the Marine Biological Laboratory at Wood's Hole, in the Library of the National Museum, the Li-

[1] Gray's first account of the box huckleberry, in which from Baird's specimens he was able to assign the species to its correct genus, Gaylussacia, was published in 1846 in his "Chloris Boreali-Americana," pp. 54–55 (*Mem. Amer. Acad.*, ser. 2, vol. 3). The quotation from the letter to Torrey cited above is from Jane L. Gray, 1893, "Letters of Asa Gray," p. 343, where the date assigned to the letter is October, 1846. By reference, however, to W. H. Dall, 1915, "Spencer Fullerton Baird, a Biography," pp. 132–134, it is clear that the meeting took place, and the letter was written, in April, 1846.

brary of the American Museum of Natural History and the Library of Congress.

HERMON C. BUMPUS

SCIENTIFIC EVENTS

THE LISTER INSTITUTE[1]

THE Lister Institute is unique among the medical establishments of London, because it is an independent organization endowed by private benefactors. The only comparable institution is the London School of Tropical Medicine, which, however, is in the enjoyment of government support. The Lister Institute is one of the schools of the University of London, admitted under the statute which empowers the senate to admit any institution within the prescribed area founded for the promotion of science or learning to be a school of the university for the purpose of research or the cultivation of any special branch of science or learning. Its director, Dr. C. J. Martin, F.R.S., is professor of experimental pathology in the university, while several members of its staff are readers or recognized teachers in the university. But its connection with the university is otherwise shadowy and its affairs are managed by a governing body which includes Major General Sir David Bruce, K.C.B., F.R.S. (chairman), Professor F. W. Andrewes, M.D., F.R.S., Professor W. Bulloch, F.R.S., Sir James Kingston Fowler, K.C.V.O., and Professor E. H. Starling, C.M.G., F.R.S., There is also a council containing representatives of the members of the Institute and of many learned bodies.

The report to be presented at the annual general meeting gives an account of the various activities of the institute during the year, and contains a section in which its future general policy is discussed. A great deal of the time of the staff of the institute—which, owing to the war, was much diminished—was given to routine bacteriological examinations for the London County Council and other public bodies, and the production of serums and vaccines for the War Office and the Government of Egypt. But some of the work done for the War Office has reached out to research, as, for instance, investigations made by Dr. Arkwright and Mr. Bacot as to the virus of trench fever and typhus fever, and the transmission of these diseases by lice. Miss Muriel Robertson has continued researches upon anaerobic bacteria of wounds and the preparation of standard samples of the toxin of *Vibrion septique* which have been used in preparing and standardizing the serums issued to the army from the serum laboratories of Messrs. Burroughs, Wellcome and Co. Much of present knowledge of the pathogenic anaerobes has been gained since the beginning of the war, and in its acquisition Miss Robertson, who is secretary of the anaerobic committee originated by the Medical Research Committee, has taken a prominent part.

In another direction researches stimulated by the war have yielded results of permanent importance to physiology and general medicine—and indeed to sociology and statecraft also. Dr. Harden and Dr. Zilva have made a series of investigations into the properties of accessory food factors and the effects of the deprivation of them on various animals. A related research was that conducted by Dr. Harriette Chick, at the request of the military authorities, into the cause of scurvy; it was eventually expanded to include certain other deficiency diseases. The research demanded the greatest care in the adjustment of the diets and the feeding of the animals, and the help of many volunteer workers was enlisted. This inquiry has had many parts, but those concerned with the quantitative determination of the relative antiscorbutic efficiency of natural foodstuffs, and with the loss of antiscorbutic value during the drying of vegetables, are now practically complete; work is still in progress with regard to the preservation of lemon juice and root vegetables, and as to the antiscorbutic and growth-promoting properties of cow's milk, with special reference to infant feeding. The novel feature of the investigations has been the attempt to get a quantitative estimate of the amount of accessory food facts in various foodstuffs, the first step being to determine experimentally

[1] From the *British Medical Journal.*

for each substance the minimum daily ration which will protect the experimental animal. A committee on accessory food factors, with Professor Hopkins as chairman and Dr. H. Chick as secretary, has been sitting during the year, and has prepared a monograph to meet the needs of the general scientific and medical reader.

SCIENCE IN AUSTRALIA

The newly founded Commonwealth Institute of Science and Industry, Melbourne, has begun the publication of a monthly journal entitled *Science and Industry*. The editorial foreword says:

No competent scientific investigator need fear the coming of the institute. It will not attempt to do work that others are doing already. There is more than sufficient work for all. No one needs to look round for a job. They are everywhere at hand. While there is still dust in Sydney's streets, or smoke issuing from the chimney stacks at the factories at Footscray, while there is waste timber being eternally burnt around the saw-mills of the west, while the molasses expressed from the sugar-cane of the north still finds its way down to the sea, who can deny the width of the field for scientific investigation? While the rich lands of Queensland are continually being given over to the prickly pear, and arable areas of Victoria to St. John's wort, while artesian water ceases to flow, or the bores to corrode, while stock die of strange diseases in the night, and their young perish before birth, while there are still mineral treasures that have not yet been exploited by the prospector, while air transport is still with us an undeveloped means of locomotion, while a thousand and one articles of daily use are still being imported from foreign lands that could easily be manufactured by our own people, who will say that there is no room for science?

Hitherto in Australia, and in most other English-speaking countries, the scientist is only now beginning to get back some of his own. In the past there has been observable a certain suspicion of science. The primary producer used to regard the man of science as a dreamer or at best a theorist. They talked of Collins-street farming. The scientific man, on his part, had little respect for those who allowed their actions to be hampered by the ideas of their grandparents. But gradually it was seen by producers that the man of science had something to teach them if they were only prepared to listen, and if he was willing to express his thoughts in every-day language. The man on the land no longer despises science as he did a quarter of a century ago—at least, the more progressive do not. The manufacturers are not precisely in the same plight. With some few and notable exceptions, they have been inclined to ignore the lessons of science. The scientists themselves are somewhat to blame for this, or, at any rate, they have themselves to thank. Business men have one test of value, and that is cost. Scientists who love their science place it above money. Much of the most valuable scientific work done in the world has been done for a pittance. The reward of the investigator was not necessarily expressed in the augmentation of his banking account. Business men could not understand this. Services that could be had cheaply were nasty. If they were valuable, they would be much sought after in the market. So argued these men of affairs, and this was the basis of those advertisements asking for the services of fully-qualified chemists at £200 a year or less. These bad old days must end if science is to come into her own. In the field of science the laborer is worthy of his hire.

The institute is the youngest department of the commonwealth government. It is not yet old and effete, with a large number of its officers eagerly looking for the retiring age. It represents the young commonwealth, youthful and virile, and realizes, as it has been expressed, that "the frontier of knowledge is the starting point of research."

SIGMA Xi AT SYRACUSE UNIVERSITY

The Society of Sigma Xi at Syracuse University has elected as officers for the ensuing year the following: *President,* Edward D. Roe, Jr.; *Vice-president,* C. C. Adams; *Secretary,* Geo. T. Hargitt; *Treasurer,* Henry F. A. Meler. During the past year the following scientific program has been presented by members of the society:

November 18. Edwin F. McCarthy. Occurrence of knots and spiral in Adirondack red spruce.

Carl J. Drake. Notes on *Nezara viridula,* a serious plant pest in the south.

December 13. R. S. Boehner. Gas warfare.

E. N. Pattee. The outlook for chemical industries in the United States.

January 10. T. C. Hopkins. Exploring and

prospecting for oil in Wyoming and Kentucky.

Chas. H. Richardson. Some results of recent geological research in Vermont.

February 6. H. S. Steensland. The action of benzol on animals.

Frank P. Knowlton. The electrocardiogram, with demonstration.

March 14. E. D. Roe, Jr. The irreducible factors of $1 + x + x^2 + \cdots + x^{(n-1)}$.

R. R. Tatnall. The production and measurement of low pressures.

April 11. L. M. Hickernell. The habits and structure of the 17-year cicada.

H. F. A. Meier. The fixation of atmospheric nitrogen by plants.

May 9. Louis Mitchell. The use of diagrams in the solution of hydraulic problems.

Rich D. Whitney. The destruction of underground structures by electrolysis.

THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY IN BRITISH GUIANA

AFTER two years of temporary suspension on account of the war, the Tropical Zoological Station of the New York Zoological Society, in British Guiana, is again proceeding with its various activities. Director William Beebe now has with him Inness Hartley, research associate, Alfred Emerson, research assistant, and John T. Van, artist. In a short time two visiting zoologists will arrive at the station for the pursuit of special studies.

In order to live and work in close proximity to the jungle and the river life of British Guiana, the old station at Kalacoon was vacated, and the new one was planted in the government Penal Settlement, at Katabo. There, in an ideal spot, a commodious laboratory and dormitory have been developed, and an extensive program of investigation has been laid out. Three tropical rivers of considerable importance, the Essequibo, Cuyuni and Mazaruni, render the whole western half of British Guiana available to the station near the meeting-place of their waters. The Mazaruni Rapids are eight miles above the station.

A garden has been planted, and Indian hunters bring to the table of the station varied supplies of tapir, deer and agouti meat and fish. Animal life in close proximity to the station is abundant, and the choice of subjects for investigation is fairly bewildering.

Again has the government of British Guiana been most liberal in promoting the objects of the station, and the Zoological Society looks forward with lively interest to the year's record of results.

SCIENTIFIC NOTES AND NEWS

THE RT. HON. JOHN WILLIAM STRUTT, LORD RAYLEIGH, the great English physicist, died on July 1, at the age of seventy-six years. His eldest son is the Hon. Robert John Strutt, professor of physics in the Imperial College of Science, London.

WESLEYAN UNIVERSITY, at its recent commencement, conferred the degree of doctor of science on Edward Lee Thorndike, '96, professor of psychology at Teachers' College, Columbia University; Frank Bowers Littell, '91, astronomer, Naval Observatory, Washington, D. C., and George Arthur Burrell, recently in command of United States Army Chemical Service.

AT the commencement of the University of Vermont the degree of doctor of letters was conferred on Dr. Liberty Hyde Bailey, formerly director of the college of agriculture of Cornell University, and the honorary degree of doctor of science on Dr. Marshall Avery Howe, curator of the museums of the New York Botanical Garden. Dr. Bailey delivered the commencement address, taking for his subject, "The aspiration to democracy."

THE honorary professional degree of master of horticulture has been conferred upon Edmund H. Gibson, of the U. S. Bureau of Entomology, by the Michigan Agricultural College.

THE agricultural building at the Kansas State Agricultural College has been named Waters Hall in honor of Dr. Henry Jackson Waters, former president of the college, now managing editor of the *Kansas City Weekly Star*.

DR. D. T. MACDOUGAL, director of the department of botanical research, Carnegie Institution of Washington, was elected a corresponding member of the Société Nationale

d'Acclimatation de France, at the meeting of May 25, under the presidency of Minister Lebrun.

The title of Commander of the Order of the Crown of Belgium has been conferred on Dr. W. J. Holland, director of Carnegie Institute, Pittsburgh, in recognition of the "devotion shown by him to the cause of Belgium."

Major W. H. Eddy, of the section of food and nutrition of the Surgeon General's Office has recently returned from abroad. After the departure of Major P. A. Shaffer, Major Eddy was in charge of the work of the section in France. He is now temporarily on duty at the Surgeon General's Office. Major F. L. Scott, of the section of food and nutrition of the Surgeon General's Office has also returned from abroad and received his discharge from the army.

President Kenyon L. Butterfield, of the Massachusetts Agricultural College, has returned from France.

Captain Lawrence J. Cole, professor of psychology at the University of Colorado, has received his discharge from the army and has returned to the university.

Professor Max Ellis, of the department of biology of the University of Colorado, who has been on leave of absence for two years engaged in government service, has resigned to accept a permanent government position.

We learn from the *Journal* of the American Medical Association that Dr. Alexander C. Abbott, of the University of Pennsylvania, who recently returned from France, where he served with the Medical Corps of the U. S. Army, has been nominated for a position on the Philadelphia Board of Health. Dr. Frank C. Hammond, who was appointed to fill the vacancy, insisted on resigning the post that Dr. Abbott might be reappointed to his former position.

The Harvard Corporation has made the following appointments on the Harvard Cancer Commission: Dr. Robert B. Greenough, director, and Drs. Channing C. Simmons, secretary (both of Boston); Roger Pierce, treasurer; James H. Wright, Boston, pathologist; William Duane, research fellow in physics; William T. Bovie, research fellow in biology; Henry Lyman, Boston, research fellow in chemistry, and Ernest W. Goodpasture, Boston, research fellow in pathology.

Dr. Winfield Scott Hall, for more than twenty years a member of the faculty of Northwestern University Medical School, Chicago, has been appointed to take charge of the newly organized department of social hygiene of the Presbyterian Board of Temperance and Moral Welfare.

Dr. Charles J. Galpin, professor of agricultural economy in the college of agriculture of the University of Wisconsin, has been appointed economist in charge of farm-life studies of the United States Department of Agriculture.

Mr. Charles Snyder, head keeper of reptiles in the New York Zoological Park, has been made director of the Buffalo Zoological Gardens.

Mr. F. Flippance, at one time a temporary assistant in the herbarium at Kew, has been appointed assistant curator of the Botanic Gardens, Singapore.

Dr. J. E. Kirkwood, professor of botany in the Montana State University at Missoula, has been granted leave of absence for a year and will work in the University of California laboratories. During his absence the department will be in charge of Assistant Professor Paul W. Graff.

Dr. K. Sato, assistant professor of agriculture in the University of Tokio, is studying problems of farm management and agricultural economics in the United States.

H. S. Gale, of the U. S. Geological Survey, has been making a survey of the potash situation in Alsace.

W. R. Ingalls has retired from the editorship of the *Engineering and Mining Journal*, but will continue as consulting editor. He has resumed practise as consulting engineer with offices in New York.

PROFESSOR J. F. KEMP has recently found among other stored articles in the department of geology of Columbia University a notebook of the late Professor John Strong Newberry, containing notes in French taken by him while a student, and covering the lectures on botany delivered by Professor Brongniart in Paris in 1849 and 1850. Through Professor Harper, Professor Kemp has transmitted this very interesting document to the New York Botanical Garden for preservation, and it has been added to the library.

DR. C. L. MARLATT, assistant chief of the Bureau of Entomology, and chairman of the Federal Horticultural Board, gave an address to the Entomological and Zoological Seminar of the Kansas State Agricultural College on May 19, on some work of the Federal Horticultural Board.

DR. ALBERT R. MANN, dean of Cornell College of Agriculture, delivered the address at the forty-ninth commencement of the Massachusetts Agricultural College at Amherst, on June 24. He spoke on "The place of the trained man in agriculture."

THE Croonian Lecture on the biological significance of anaphylaxis was delivered on May 29, before the Royal Society, by Dr. H. H. Dale, F.R.S., director of the biochemical and pharmacological department of the Medical Research Committee.

SIR ARTHUR NEWSHOLME gave a public address on the evening of June 20, at the University of Toronto, on "Some problems of preventive medicine of the immediate future." Sir Arthur was the guest of honor at a dinner given by Dr. Edmund E. King, Toronto, president of the Academy of Medicine.

FATHER WALTER SIDGREAVES, S.J., director of the Stonyhurst College Observatory, known for his contribution to stellar spectroscopy and other work, died on June 12, in his eighty-second year.

THE four hundredth anniversary of the death of Leonardo da Vinci was celebrated at Naples on May 2. The *British Medical Journal* states that an address was delivered by Professor Filippo Bottazzi. The great artist was an enthusiastic anatomist. He began his studies in the Hospital of Santa Maria Nova at Florence in 1489, when he was in his thirty-seventh year, and continued them at Milan in the Ospedale Maggiore and the Collegio die Fisici, and afterwards at Rome in 1513 till they were forbidden by Leo X., on a denunciation of body-snatching made by some German enemies. He dissected more than thirty bodies of men and women of various ages, and his observations were collected in one hundred and twenty books; much of the manuscript has been lost, and the drawings designed to illustrate the text of a great work on anatomy to have been written in conjunction with Marc' Antonio della Torre, the famous professor of Pavia, lay forgotten in the Ambrosian Library at Milan, and afterwards in the Royal Library at Windsor, until they were discovered in 1902. They are now in course of publication.

THE faculty of the North Dakota Agricultural College, organized under the name College Teachers Organization, voted on June 9 to apply for a charter in the American Federation of Teachers. Eighty per cent. of the teaching staff are members of the new organization.

THE annual general meeting of the Society of Chemical Industry will be held in London on July 15–18, under the presidency of Professor Henry Louis. *Nature* states that on July 15 there will be a conference at the Mansion House, when addresses will be given by representatives of the Inter-Allied Conference. Sir William J. Pope, chairman of the Federal Council for Pure and Applied Chemistry, will open the conference. The subjects of other conferences will be: Power Plant in Chemical Works; Empire Sugar Production; Dyestuffs, Synthetic Drugs and Associated Products; The Chrome Tanning Industry; and Recent Developments in the Fermentation Industries. A reception will be held at the British Scientific Products Exhibition, Central Hall, Westminster, on July 17.

WASHINGTON UNIVERSITY SCHOOL OF MEDICINE has received a grant of $5,000 to be used

for the investigation of hypertrichiasis, from a person whose name is for the present withheld. A committee in charge of the grant has been appointed, consisting of the dean, Dr. G. Canby Robinson; Dr. M. F. Engman, of the department of dermatology, to whom the grant was proposed, and Dr. Charles H. Danforth, of the department of anatomy, who will carry on the investigation which will be chiefly in the fields of anthropology and heredity.

A "Roosevelt Institute of American Family Life," to be developed in connection with the eugenics record office of the Carnegie Institution, in Washington, has been proposed to the Roosevelt Permanent Memorial National Committee by the Eugenics Research Association of Cold Spring, Long Island. The association in outlining the project explains that it owns eighty acres of land in Roosevelt's own voting district, and has already laid the foundation for the study of the factors controlling American family life. In the announcement, which proposes the erection of the memorial institute at Oyster Bay, the association declares: "This memorial institute will strive to advance those ideas of responsible and patriotic parenthood for which Theodore Roosevelt so valiantly battled." In addressing the national committee the association wrote: "We respectfully call your attention to the following factors which contribute to the fitness of this suggestion: The Roosevelt memorial should, like the man in whose memory it is built, battle for the advancement of the eugenical ideal in American family life. It should be located in Roosevelt's own neighborhood. The safety of the foundation fund could be absolutely secured by placing it as trust with the Carnegie Institution of Washington. Its proximity to New York City makes the Oyster Bay neighborhood an exceptionally fitting place for the institute."

UNIVERSITY AND EDUCATIONAL NEWS

Harvard University is bequeathed $100,000 for the study of methods to reform and cure criminals and mental defectives by surgery under the will of Dr. J. Ewing Mears.

In accordance with the will of the late Clementine C. Conkling, real estate in the city of Omaha to the value of approximately twenty-five thousand dollars has been bequeathed to the college of medicine, University of Nebraska, Omaha.

The Goldsmiths' Company has offered the sum of £15,000 to London Hospital for the endowment of a chair of bacteriology, to be known as the Goldsmiths' Company's chair of bacteriology.

The Utah Agricultural Experiment Station recently established a department of human nutrition. R. L. Hill, Ph.D. (Cornell), formerly of the Maryland Agricultural Experiment Station and first lieutenant in the Sanitary Corps of the Army, has been appointed head of the department with Blanche Cooper, B.S., formerly nutrition expert for the Utah Agricultural College Extension Division, associate.

Dr. Harry Woodburn Chase, professor of psychology, has been elected president of the University of North Carolina.

Dr. A. F. Kidder has resigned as professor of agronomy in the college of agriculture, Louisiana State University, to accept a position as agronomist and assistant director of the State Agricultural Experiment Station at Baton Rouge.

Nathan Fasten, B.S. (C. C. N. Y. '10), Ph.D. (Wisconsin, '14), has been promoted to the rank of assistant professor of zoology at the University of Washington, Seattle.

Professor T. Brailsford Robertson, professor of biochemistry in the University of Toronto, has been appointed to succeed the late Sir Edward C. Stirling as professor of physiology in the University of Adelaide, South Australia.

Mr. W. L. Bragg has been appointed to the Langworthy chair of physics in the University of Manchester in succession to Sir Ernest Rutherford.

DISCUSSION AND CORRESPONDENCE

THE DISCOVERY OF CACULUS

TO THE EDITOR OF SCIENCE: The writer desires to call attention to certain disclosures here pointed out for the first time, whose conclusions are decisive in the matter of the celebrated controversy between Newton and Liebniz, regarding the discovery of calculus. It is admitted that Leibniz was in full possession of his calculus, at the time of his second visit to London, in September, 1676, and that during the week in London, he made copious extracts from Newton's "De Analysi Æquationes Numero Terminorum Infinitas," which was in the hands of Collins, where it had been placed by Barrow in 1669, with the consent of Newton.[1] Besides containing the binomial theorem, expansions of trigonometric functions, etc., it was a complete treatise on fluxions. Found among Collins's papers after his death, it was published in 1711.

Leibniz's first information *from Newton* that this work existed, and where it was to be found, came from Newton's second letter of October 26, 1676, which reached Leibniz some months later in Germany. I quote the "Encyclopedia Britannica" (Inf. Calc.) as to the contents of this letter:

> Newton proceeds to state that about 1669 he communicated through Barrow to Collins a compendium of his method subsequently called "the method of fluxions," with applications to areas, rectification, cubature, etc. *In* this letter, however, he gave no explanation of this method, carefully concealing its nature in an anagram of transposed letters. . . .

Leibniz's reply to this letter has been termed one of "noble frankness" in contrast to Newton's secrecy. This frankness, however, did not consist in informing Newton of the week but recently spent with Collins, in careful examination of the very compendium to which he referred, and that his anagram was useless. On the contrary, Leibniz renewed statements of ignorance of Newton's method, and with seeming frankness, imparted his calculus to Newton in every detail, thereby laying the foundation of a plot to deprive Newton of all credit, whose subsequent details were carried out on a timed schedule.

Thus, on the first publication of a work on fluxions by Newton in 1704, an unsigned and unfavorable review in the "Leipzig Acts" for 1705, stated that Newton uses and always has used fluxions for the differences of Leibniz. A few years later, Leibniz, who was the author of this indirect charge, made it still clearer in a letter to Count Bathmar, which was published, stating that Bernouilli had written to him that Newton had apparently fabricated his calculus after having seen his own. Later than this, again, a letter was distributed over Europe, making the same direct charge, but without containing the name of its author, printer or place of publication.

From Leibniz's examination of Newton's compendium of fluxions on his second visit to London, it is absolutely certain that he possessed personal knowledge that these infamous charges against Newton were false.

It must be explained how Leibniz knew of the existence of that compendium in Collins's hands when he went to London, out of his way from Paris to Hanover, and how he knew that it contained what he wished to see. Newton's first letter to Leibniz, June 13, 1676, gave all the important theorems on series which were contained in that compendium, although his letter neither stated this fact, nor gave explanations. In his reply of August 27, 1676, Leibniz expressed great interest, and asked for their explanation and then shortly after went to London and read all about them, the opportunity for this journey being a request from the Duke of Hanover to return to Germany.

The only reasonable supposition is that Leibniz had seen this manuscript on his first visit to London, in 1673, and thus knowing of its existence, and that it contained these series, the new interest which they aroused caused the second visit, for the purpose of re-reading them in the light of an improved mathematical knowledge.

The probability of the truth of this supposition is increased when we take into account the character of the man and the cir-

[1] Cajori, "A History of Mathematics," p. 230.

cumstances which surround the first visit. He was continually employed throughout life in typical German propaganda, and was accustomed to political deceit. In 1669, under the guise of a Catholic Polish nobleman, he wrote a tract which undertook to mathematically demonstrate to his supposed countrymen, the Poles, that it was for the best interests of Poland to elect the German candidate for their throne. The political mission which brought him to Paris in 1672 was to secure France as an ally of Germany in a proposed war of conquest against the Turk, the bait to France being the possession of Egypt, "one of the best situated lands in the world." This project was finally laughed from the court of Louis XIV.

While in Paris, Leibniz corresponded with Oldenberg and Collins. The former was Secretary of the Royal Society of England, and had in charge all papers and manuscripts of the society. He was for many years a German agent in London whose services as secretary were given without pay. Confined in the Tower as a spy in 1669, the Royal Society adjourned its meetings until his release.[2]

Collins was the closest friend of Newton, and spent his entire time in obtaining the latest mathematical information and in corresponding with mathematicians about it. These two men, Oldenberg and Collins, always appear as instruments of Leibniz in his dealings with London affairs and with Newton, but all communications seem to have passed through Oldenberg's hands.

After 1669, when Collins obtained the compendium of fluxions above mentioned, there was much correspondence about fluxions between Newton, Collins and other mathematicians, and on December 19, 1672, Newton sent a letter to Collins which was designed to explain fluxions to any intelligent person, with one illustrative example, which Collins immediately began to communicate to all of his correspondents.

Leibniz was in London, January 11, 1673. and remained until March following. Application for membership in the Royal Society had preceded him, and he attended all of its meetings, read mathematical papers before it, and made claim to a differential method for series as his own invention, which Pell identified as the method of Mouton, a Frenchman, very much to Leibniz's discomfort. He had discussions with Oldenberg and Collins regarding series, and we must remember that the latter possessed, in Newton's compendium on fluxions, the latest and most remarkable series of the time. That Leibniz had free access to the manuscripts in the hands of these men, and read them, would appear from his notes of this visit, discovered in 1890, in the royal library at Hanover. These show extracts from Newton's "Optics," and from other authors, and a remarkable absence of notes on mathematics, his chief subject of interest at the time.

Returning to Paris in March, Leibniz placed himself under the guidance of Huygens in higher mathematics, and began the development of his calculus. It was well in hand by December, 1675, and the question arose, how to deal with Newton. The plan adopted was to have Newton informed that Leibniz had heard that he had a method for series, tangents and the like, and requested information about it, as he had one of his own. It required the united persuasions of Oldenberg and Collins, and an appeal that it was for the honor of England, to overcome Newton's objections and bring about the first letter of June 13, 1676, already mentioned. The ostensible purpose of the correspondence is to learn Newton's method, yet he held Newton's compendium of it in his possession for a week, the following September, and since its pages were opened freely to him at that time, it is constructive proof that they were as freely open to him for the two months in 1673 that he was in London.

The sudden death of Oldenberg in 1677 prevented an answer to the letter of "noble frankness." but when the "Principia" was published in 1687, Newton inserted a scholium containing the statement that a letter from Leibniz had shown that that distinguished

[2] See Weld, "History of the Royal Society," Vol. 1, pp. 201, 259.

man had fallen upon a method which scarcely differed from his except in its forms of words and symbols.

It is not known how far Collins was in the confidence of Leibniz, but it has been noted that following Collins's death in November, 1683, appeared the *first publication* of Leibniz's calculus, in the "Leipzig Acts" for 1684, essentially as it was given to Newton in 1677.

Additional force is given to the supposition that Leibniz saw Newton's compendium in 1673 by the similarity of the circumstances to those which relate to German propaganda as it has been disclosed by the recent war, a similarity so striking, that one hardly realizes that the period concerned is practically two and one half centuries nearer the origin of such methods. But the letter of "noble frankness" with the unquestioned facts which throw light upon it, are alone sufficient to bar Leibniz from the honor of an independent discoverer, for no other reason than that, as we say in the law, he does not come into court with clean hands.

ARTHUR S. HATHAWAY
PURDUE UNIVERSITY

THE POOR DIENER

How many of us have not felt as we closed an article that we may have thought good, perhaps expressing perfunctory thanks to our patron or instructor or some other figure in the seats of the mighty who took a few minutes time to send us some preparations or cultures prepared by some one else in his laboratory, that there was a hardworked, somewhat pathetic humbler figure back of it all to whom our thanks are far more due than to any of these?

When you take down from the shelf a carefully cleaned, carefully sterilized, cotton-plugged flask and fill it up for your own purposes, and then cheerfully discard it and take another because you got in a tenth of a centimeter too much, when you finish up a couple of hours brisk work and then carry out a trayful of pipettes to the "dirtroom" to be washed up, and leave around a staggering array of dirty glassware too bulky to bother to take out yourself, when you pile up on the sterilizing bench a great lot of used, gone and forgotten cultures for some one else to autoclave, then remember the poor diener.

When you toss over a foul sample of sputum with a "Here Jim, stain this up and look for the bugs," or hack out a bloody mess of tissues from a dead guinea pig and hand them over with a curt "Shove these into Zenker, George, and run 'em through as fast as you can," give credit where credit is due. These are not operations that can be carried on by any old man in the street; these are true science.

Dozens of procedures which we learned with difficulty in school days, we turn over to dieners and technicians, who learned the art from other dieners and technicians and carry it on in a clean-cut mechanical way better than we could do ourselves. God help science if all the dieners should unionize and go on a strike to-morrow.

E. R. L.
SARANAC LAKE

SCIENTIFIC BOOKS

RECENT PALEOBOTANY IN GREAT BRITAIN

THE following survey of paleobotanical researches published in Britain during the war is necessarily superficial; it is, moreover, obviously impossible to draw a clearly defined line between work done in the period immediately preceding the outbreak of hostilities and work completed since August, 1914. No mention is made of papers which, though primarily concerned with recent plants, include references to extinct types. In spite of the fact that national work of one kind or another has absorbed, wholly or in part, energies normally devoted to scientific research the record of achievement amply justifies the statement that the progress of paleobotanical enquiry has not suffered any serious check. Much has been done towards quickening the spirit of research in pure science as well as in relation to problems of great economic importance: the foundations of paleobotanical knowledge have been considerably strengthened and, with the access of greater opportunities and revived interest in research which we confidently expect in the days to come, the results gained during the period of storm and

stress will unquestionably exercise a stimulating and directive influence upon future investigations.

Through the death of Mr. Clement Reid (December, 1917) paleobotany has lost one of the ablest and most careful observers in a neglected field of British botany, namely, the investigation of the composition of European floras subsequent to the advent of the flowering plants as the dominant class. In his later work he had the benefit of the assistance of his wife by whom, it may confidently be expected, questions connected with the origin of the British flora will be further elucidated. Dr. Newell Arber, who died in June, 1918, was one of the most indefatigible and enthusiastic students of ancient floras, particularly those of Paleozoic and later Mesozoic age. He accomplished much in a comparatively short life and by his whole-hearted devotion to research exercised a wide influence upon younger men. Miss Ruth Holden, though an American citizen, left her paleobotanical work in this country at the end of 1916 to join a British medical unit in Russia where she died in April, 1917. By her death paleobotany lost an exceptionally gifted and promising student.

Books.—The second part of "The Cretaceous Flora"[1] by Dr. Marie Stopes, a volume of a series of British Museum Catalogues of the fossil plants in the national collection is devoted to an account of Lower Greensand (Aptian) plants, principally Conifers and extinct types of Cycadophyta. The introductory chapter includes an interesting sketch of the general facies of Lower Greensand floras and a discussion on the climatic conditions under which the plants lived. A remarkable new genus (*Colymbea*) of Cycadophyta is described and new types of dicotyledonous wood. The author's work affords striking evidence of the highly specialized structure of some of the oldest dicotyledonous trees of which we have any detailed knowledge. Volume III. of "Fossil Plants,[2] a text-book for students of Botany and Geology" by the writer of this article published in 1917 continues the account of Pteridosperms and Cycadofilices begun in Vol. II. and deals with recent and fossil Cycadophyta, the Cordiatales, and fossil gymnospermous seeds. The concluding volume has been printed and will be published as soon as circumstances permit.

Papers.—1. *Pre-Carboniferous Plants.* One of the most important paleobotanical contributions of recent years, a paper of exceptional interest, is the memoir by Dr. Kidston and Professor Lang[3] on a new genus of plants, *Rhynia Gwynne-Vaughani,* beautifully preserved as an almost pure growth in beds of chert in the Old Red Sandstone of Aberdeenshire. The chert consists of a series of peat beds which were periodically inundated and eventually covered by a layer of sand. The silicified peat is almost entirely composed of the prostrate stems and rhizomes of the leafless and rootless *Rhynia.* This oldest land plant of which the internal structure is at all fully known consisted of a branched underground rhizome attached to the soil by rhizoids bearing occasionally forked, slender, leafless aerial branches. The vegetative organs bore small hemispherical protuberances some of which developed into adventitious branches. The reproductive organs are represented by elongate isosporous synangia probably borne at the end of the main axes. A new group, the Psilophytales, is instituted for this exceptionally interesting plant which is compared with *Psilotum* and with the Devonian *Psilophyton princeps.* Dr. Arber and Mr. Goode[4] record the occurrence of a few fragmentary impressions of land plants from Devonian rocks of North Devon including specimens of slender repeatedly forked axes with terminal cupule-like organs which they refer to a new genus *Xenotheca* believed to represent the fertile shoots of a Pteridosperm.

[1] "Catalogue of the Mesozoic Plants in the British Museum" (Nat. Hist.), The Cretaceous Flora, Pt. II., London, 1915.

[2] "Fossil Plants," Vol. III., Cambridge, 1917.

[3] *Trans. R. Soc. Edinburgh,* Vol. LI., Pt. III., p. 761, 1917. See also British Assoc. Report, 1916, p. 206.

[4] *Proc. Cambridge Phil. Soc.,* Vol. XVIII., Pt. III., p. 89, 1915.

The Devonian species belong to the oldest land-flora so far described from English strata. A paper by Messrs. Don and Hickling[5] gives by far the best account we possess of *Parka decipiens*, a problematical Old Red Sandstone discovered in 1838 and referred to different positions in both the animal and vegetable kingdoms. It occurs, in the form of flat circular or oval flattened mummified bodies enclosing numerous circular groups of spores, in the lower beds of the Caledonian Old Red Sandstone and in passage beds between the Old Red and Silurian. The authors make out a good case for its inclusion in the Thallophyta as an extinct type with Algal affinities. Mr. Don, a student of unusual promise, obtained a commission in the early days of the war and died at Salonika in April, 1916.

2. *Carboniferous Plants.*—Additions have been made to our knowledge of Carboniferous floras by several authors. Dr. Kidston[6] published in 1916 the first of a projected series of papers on plants from the Scottish Coal Measures in which are described two new species of *Sigillaria*, two new types of *Sphenopteris*, and a new species of seed referred to the genus *Lagenospernum*. The same author[7] has described several plants from the Forest of Wyre coalfield and from the Tetterstone Clee Hill coalfield. Dr. Arber[8] in a paper dealing with plants from the Red Clay series and the Middle Coal Measures of the Staffordshire coalfield proposed a new generic name, *Calamophloios*, for casts and impressions of Calamite stems in which the external surface and not the surface of the pith-cast is preserved. These papers on Carboniferous floras supply important data towards a more complete classification of coal-bearing strata in Britain on the basis of the fossil plants. Miss Lindsay[9] contributes new facts in a short account of the method of branching and the phenomena of branch-shedding in *Bothrodendron*.

Dr. Scott in an interesting sketch of the forests of the coal age[10] discusses the evidence afforded by paleobotanical investigations on the conditions under which the plants grew; he draws attention to the high degree of organization exhibited by Paleozoic species, a fact which has not hitherto been sufficiently realized in discussions of problems connected with evolution. The same author[11] has published a valuable and comprehensive account of the genus *Heterangium*, one of the best known examples of the very important extinct Paleozoic group of pteridosperms, plants with fern-like foliage-bearing seeds and possessing anatomical characters denoting a close affinity to gymnosperms. He institutes a new subgenus *Polyangium* to include several species characterized by compound leaf-traces and other distinctive features in contrast to another set of species, in which the leaf-trace is single in origin, referred to the subgenus *Eu-Heterangium*. The Polyangium forms indicate a closer relationship between the Lyginopteridese and the Medulloses and Calamopityeæ than has hitherto been suspected. This paper is an admirable example of the importance of revising from time to time in the light of fresh discoveries our knowledge of extinct genera. Dr. Scott[12] has recently described a new species of another Carboniferous genus founded on petrified stems, *Mesoxylon multirame*, characterized by the presence of many axillary shoots and other morphological features. A preliminary account is added of a small stem associated with *Mitrospermum* seeds which it is believed may belong to Mesoxylon. Dr. Nellie Bancroft's careful re-investigation of Williamson's *Rachiopteris cylindrica*[13] from the Lower Coal Measures of Yorkshire reveals the existence of two types of this fern which she regards

[5] *Quart. Jour. Geol. Soc.*, Vol. LXXI., Pt. IV., p. 648, 1917.

[6] *Trans. R. Soc. Edinburgh*, Vol. LI., Pt. III., p. 709, 1916.

[7] *Ibid.*, Pt. IV., p. 999, 1917.

[8] *Phil. Trans. R. Soc. London*, Vol. 208, Series B, p. 127, 1916.

[9] *Annals of Botany*, Vol. XXIX., p. 223, 1915.

[10] *Trans. Instit. Mining Engineers*, Vol. LIV., Pt. II., p. 33, 1917.

[11] *Jour. Linn. Soc.*, Vol. XLIV., p. 59, 1917.

[12] *Annals of Botany*, Vol. XXXII., p. 437, 1918.

[13] *Ibid.*, Vol. XXIX., p. 531, 1915.

as habitat-forms of one species, the differences in structure being attributed to the influence of water. In this as in many other recently published papers it is satisfactory to find that authors are now paying more attention than formerly to the significance of structural features as indices of climate and habitat. Mr. Sahni's critical morphological study of the branching of the leaf-trace in certain Carboniferous genera of ferns[14] throws light on some previously misunderstood anatomical features and illustrates the value of the application of broad philosophical generalizations based on intensive study of allied forms. Miss Holden's account of the anatomy of two Paleozoic Cardaitalean stems from India;[15] placed in the genus *Dadoxylon*, supply welcome information on the structure of plants belonging to the *Glossopteris* flora: the occurrence of well marked rings of growth in the wood of both species is a fact of special interest from the point of view of the climatic conditions under which the plants of the southern flora flourished. A report of a British Association Committee published in 1917 summarizes opinions on the vexed question of the classification[16] of the older rocks of Gondwana land in which plants of the *Glossopteris* flora are preserved.

Researches of both scientific and economic interest into the composition and mode of origin of coal have in recent years attracted the attention of several workers. The most important piece of work of this kind is that by Dr. Stopes and Dr. Wheeler,[17] a happy combination of expert botanical and chemical knowledge. The authors begin by defining ordinary coal as a "compact, stratified mass of mummified plants free from all save a very low percentage of other matter," that is practically a deposit of plants alone. It is rightly claimed that too little attention has hitherto been paid to research following logical deductions from our knowledge of the chemical composition of plants. The authors deal with modes of accumulation of coal-forming vegetable material action of the solvents on coal, the effect of heat, distillation at different temperatures, microscopic evidence bearing on the constitution of coal derived both from the coal itself and from the petrified tissues preserved in the calcareous nodules of certain coal seams. A very useful bibliography is appended. Mr. Lomax[18] has continued his microscopical analysis of coal seams and discusses the part played by different plants and parts of plants in the composition of coal. Similarly Mr. Hickling,[19] who writes on the micropetrology of coal, reviews previous work and gives the results of original observations; he attributes differences in coal rather to the result of varying degrees or varying modes of alteration than to differences in the nature of the original constituents.

3. *Mesozoic Plants.*—Dr. Arber's memoir, published shortly before his death, on the older Mesozoic floras of New Zealand,[20] is a particularly welcome contribution to our knowledge of the little known botanical history of that country. He deals with Triassic-Rhætic, Jurassic and Cretaceous plants. The author shows that no Palæozoic flora has so far been discovered: the absence of any undoubted examples of the common southern hemisphere genus *Glossopteris* leads him to express the view that New Zealand did not form part of that extensive continent known as Gondwana land in the Permo-Carboniferous period. An account is given of a remarkable petrified forest at Waikawa, Southland, consisting chiefly of some conifers and well-preserved osmundaceous stems. Dr. Arber's work clears up many obscure points and corrects erroneous statements by previous authors.

Important contributions have been made to our knowledge of Jurassic plants, notably the description of a new genus, *Williamsoniella,*

[14] *Ibid.*, Vol. XXXII., p. 369, 1918.

[15] *Annals of Botany*, Vol. XXXI., p. 315, 1917.

[16] British Assoc. Report, 1917, p. 106.

[17] Monograph on the Constitution of Coal. Dpt. Scientific and Industrial Research, London, 1918.

[18] *Trans. Instit. Mining Engineers*, Vol. L., Pt. I., p. 127, 1915.

[19] *Ibid.*, Vol. LIII., Pt. III., p. 137, 1917.

[20] New Zealand Geol. Survey, Paleontological Bulletin No. 6, Wellington, 1917.

of Cycadophyta by Mr. Hamshaw Thomas[21] (now Captain Thomas) founded on material collected by him at Gristhorpe bay on the Yorkshire coast. This genus possessed fertile shoots bearing small ovules and interseminal scales crowded on a pyriform axis and surrounded at the base by a whorl of microsporophylls each bearing 5–6 synangia. The bisexual shoots were almost certainly borne in the forks of a slender dichotomously branched stem like that of *Wielandiella,* and there are good grounds for regarding the supposed fern leaves known as *Tacniopteris vittata* as the foliage of this Bennettitalean plant. Mr. Thomas's discovery[22] of a bed of mummified plant remains in the Lower Estuarine series at Roseberry Topping, Yorkshire, enabled him to investigate minutely the epidermal characters of the problematical genus *Thinnfeldia;* he believes that the fragments of leaves and twigs of which the deposit is mainly composed were borne on trees, an interesting suggestion at variance with previous views on the nature of the genus. This author also describes a Yorkshire specimen of *Williamsonia*[23] in the Paris Museum which is probably the male flower of *Williamsonia gigas.*

Miss Holden's account of a new type of coniferous stem, *Metacedroxylon*[24] from the Corallian of Sutherland, Scotland, adds another to an already long list of Mesozoic types exhibiting a mixture of Abietineous anatomical characters. An examination by the same author[25] of impressions of Wealden fronds previously referred to the genus *Cycadites* and believed to be closely allied to the recent *Cycas* shows that they should be transferred to *Pseudocycas.* A paper by Mr. Clement Reid and Mr. Grove[26] on Characeæ from the Purbeck of Dorset gives a preliminary account of their researches into the fossil representatives of this neglected family; they describe a new genus, *Clavator,* characterized by club-like nodes on the stem and by other characters. Dr. Marie Stopes has instituted a new genus, *Planoxylon,*[27] for a Cretaceous New Zealand coniferous stem combining Abietineous and Araucarian features; she suggests that this generalized type points to the existence in the southern hemisphere of an extinct group of conifers of unexpectedly Abietineous affinities. The same author[28] describes the structure of the first specimens of roots of *Bennettites* so far discovered.

Several papers by Dr. Ellis[29] deal with fossil fungi and include descriptions based on characters of doubtful value of some supposed new species from Jurassic and Cretaceous rocks; the author also discusses the rôle of microorganisms in the formation of ironstones.

4. *Tertiary and Pleistocene Plants.*—Mr. Dutt's careful account of *Pityostrobus macrocephalus,*[30] believed to be allied to *Pinus excelsa,* from the Lower Eocene of the London Basin is an interesting morphological contribution and reveals the occurrence of unusual features in this well-preserved Abietineous cone which have been overlooked by previous authors. Papers by Mr. Clement Reid[31] and by Professor Marr and Miss Gardner[32] extend our knowledge of the Arctic Pleistocene flora of England and of the conditions under which the plants grew.

In his "Notes on *Calamopitys*"[33] Dr. Scott deals with the same fulness and critical insight with the known species of this Lower Carboniferous genus, a type showing certain affinities to *Lyginopteris* and *Heterangium.* We have unfortunately no knowledge of its reproductive organs. The paper contains

[21] *Phil. Trans. R. Soc.,* Vol. 207, Series B, p. 113, 1915.

[22] *The Naturalist,* January 1, 1915, p. 7.

[23] *Proc. Cambridge Phil. Soc.,* Vol. XVIII., Pt. III., p. 105, 1915.

[24] *New Phytologist,* Vol. XIV., p. 205, 1915.

[25] *Ibid.,* Vol. XIII., p. 334, 1914.

[26] *Proc. R. Soc.,* Series B, Vol. 89, p. 252, 1916.

[27] *Annals of Botany,* Vol. XXX., p. 111, 1916.

[28] *Ibid.,* Vol. XXXI., p. 257, 1917.

[29] *Proc. R. Soc. Edinburgh,* Vol. XXXV., Pt. I., p. 110, 1915; *Knowledge,* Vol. XXXIX., p. 73, 1916; *Geol. Mag.,* Vol. IV., p. 102, 1917.

[30] *Annals of Botany,* Vol. XXX., p. 529, 1916.

[31] *Quar. Jour. Geol. Soc.,* Vol. LXXI., p. 155, 1917.

[32] *Geol. Mag.,* Vol. III., p. 339, 1916.

[33] *Jour. Linn. Soc.,* Vol. XLIV., p. 205, 1918.

much that is new and is a valuable contribution to the difficult subject of the interrelationship of several Palæozoic plants exhibiting remarkable complex anatomical features.

A. C. Seward

University of Cambridge

SPECIAL ARTICLES

THE BLACK CHAFF OF WHEAT

The continued prevalence of black chaff of wheat in the United States makes it desirable to have a Latin-scientific name for the bacterial organism causing it. This organism resembles *Bacterium translucens* (see *Journal of Agricultural Research*, Vol. XI., p. 625, 1917), cause of the bacterial blight of barley. In cross inoculations on the leaves of seedling plants the barley organism on wheat has proved either non-infectious or has produced small non-typical lesions. On the other hand, inoculation experiments have shown that the wheat organism is practically as pathogenic on barley as it is on wheat and the lesions so produced on barley are indistinguishable from those produced by the barley organism itself. There also appear to be minor cultural differences. It is suggested, therefore, that for the present, at least, the wheat organism be distinguished as *Bacterium translucens* var. undulosum with, in general, the characteristics already given for the species:

Var. undulosum nov. var., cause of the black chaff disease of wheat, produces yellow or translucent stripes on leaves, water-soaked or black stripes on culms, and longitudinal, more or less sunken, dark stripes or spots on the glumes. In moist weather the bacteria often ooze to the surface of the diseased spots or stripes as tiny beads or drops, drying yellowish. From sections of diseased leaves or glumes mounted in water they ooze in enormous numbers (like smoke out of a chimney) making the fluid cloudy. This organism attacks also the kernels, especially at the base causing them to be shrunken and honeycombed with bacterial pockets, but even when the kernels are not attacked their surface is liable to be infected from the diseased glumes. When the disease appears early and is severe the heads are dwarfed. Surface colonies on thin-sown agar plates are circular, pale yellow, smooth (like polished glass) and structureless on the surface, usually homogeneous also by direct transmitted light, but by oblique transmitted light (half-light) the interior is seen to be full of minute waves or interblending striations which persist, and which are best seen with a hand lens. It can be distinguished easily and quickly from accompanying non-parasitic yellow forms by this character alone. Slime copious and very pale yellow on potato agar; on whey agar very copious and bright chrome yellow—slime on this medium deeper yellow and less fluid than that of the barley organism.

Infections have been obtained repeatedly on wheat leaves and glumes. The disease is transmitted to young seedlings by way of the wheat kernels. It occurs in all the wheat states of the Middle West.

For earlier notes consult Science, N. S., Vol. XLIV., No. 1134, p. 432, 1916, the *Journal of Agricultural Research*, Vol. X., No. 1, 1917, and the *Plant Disease Bulletin* (issued by The Plant Disease Survey, Bureau of Plant Industry, U. S. Department of Agriculture), Vol. I., No. 2, 1917, and Vol. II., No. 6, 1918.

Erwin F. Smith,
L. R. Jones,
C. S. Reddy

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY. V

The rapid determination of titanium in titaniferous iron ores: John Waddell. The ore is fused in a silver, copper or iron crucible with sodium peroxide, for about ten minutes. The crucible with the fused mass is brought into a beaker with water, and the disintegrated material dissolved in sulphuric acid. Tartaric acid is added to keep the titanium in solution. Sulphuretted hydrogen is passed through the solution. If a copper or silver crucible has been used, the precipitated sulphide is filtered off, and to the filtrate, ammonia is added and more sulphuretted hydrogen is passed. To the filtrate from the iron sulphide, sulphuric acid is added and the solution is boiled to drive off the

sulphuretted hydrogen and to coagulate the sulphur. After filtration, the solution can be made up to a given volume, and an aliquot portion taken for comparison of the color produced by addition of hydrogen peroxide, with that of a standard titanium solution. Or, the titanium may be precipitated with cupferron, and the precipitate burned and weighed as titanium oxide. A standard magnetite of the Bureau of Standards containing 0.99 per cent. TiO_2 was analyzed, and the results were within a few hundredths of a per cent. of that given. Concordant results were also obtained with an ore containing between thirteen and fourteen per cent. of TiO_2. Fusion of the ore with borax in a platinum crucible also gave satisfactory results, the disintegration of the fused mass being however not so rapid as when sodium peroxide was used.

The calculation of the efficiency of the silent discharge process for nitrogen fixation: F. O. ANDEREGG. Oxygen combines with nitrogen in the silent discharge. The discharge evidently changes the comparatively inert molecule into a more active condition which is probably atomic. The energy required for this activation is all that is necessary for the fixation of nitrogen. The splitting up of the molecules is probably the result of electrons, which have acquired a suitable velocity by falling through a minimum potential gradient colliding with the oxygen or nitrogen molecules. To calculate this energy of activation of oxygen use may be made of the fact that ultra-violet light of a wave-length shorter than 190 $\mu\mu$ is completely absorbed by oxygen with ozone being formed. This corresponds to a potential gradient of about 6.4 volts using the quantum theory. Then to activate one mol of oxygen requires about 146 large calories. For nitrogen the wave-lengths have not been similarly determined but the recent work of Davis and Goucher[1] makes the value of 9 volts seem to be a likely one. This corresponds to 207 calories per mol. At ordinary temperatures in the silent discharge the nitric oxide first formed is oxidized not merely to tetroxide but, because of the excess of ozone, to pentoxide, requiring one more active oxygen for this step. The complete reaction for the formation of nitric acid anhydride is then

$$2N(-207) + 20(-146) + O_2 + O(-73) = N_2O_5(+1.4) + 427.4 \text{ calories.}$$

The numbers in brackets represent the values in large calories required for the formation of the substance from the ordinary molecular condition of the elements. On an efficiency basis this amounts to about 250 grams of nitric acid per kilowatt hour. This possible yield compares favorably with the 134 grams obtainable from the union of oxygen and nitrogen at 4,200° A. in the purely thermal process. In practise a combination of the thermal and electrical process is used. Similarly in the formation of ozone the limiting yield is about 510 grams per kilowatt hour as compared with 80–90 grams, the best results actually obtained with an efficiency of 15–17 per cent.

[1] *Phys. Rev.*, 13, 1–5, 1919.

The viscosity of casein solution—I., the effect of P_H: HARPER F. ZOLLER. The study of the viscosity of casein in alkaline solutions was taken up with the ultimate object of determining its chance relationship to the adhesiveness of such solutions. Viscosity curves of Hammarsten and Dairy Division caseins dissolved in sodium hydroxide show a maximum viscosity in the region of 9.0 P_H. The slope of the curve is very precipitous on either side of the maximum. The hydrogen-ion concentration was measured both colorimetrically and electrometrically; the Clark electrode-vessel being employed for the latter determinations. A great significance is attached to the flattening of the viscosity curves immediately following the decline from the maximum. This is intimately correlated with the alkaline hydrolysis and evolution of ammonia in this zone. Solutions of casein in ammonia do not exhibit the precipitous decline from the maximum viscosity, although the maximum is in the same narrow region of P_H. The observations of Sakur, Pauli, Chick and Martin and Robertson were reviewed.

Periodic vibrations in gels: J. M. JOHLIN.

Boiling point of liquids: F. P. SOEBEL. Basing his deductions on the assumption that at the boiling point of a liquid the vibratory energy of individual molecular constituents of the liquid and of its vapor must be equal, the author finds that the absolute temperature T_x of the boiling point of an absolutely pure liquid is expressible as

$$T_x = \frac{mp_xvx}{1.49}$$

in which formula m represents the molecular weight of the substance or compound and p_x and v_x the pressure and volume of the vapor at the temperature T_x. For ordinary liquids containing impurities lowering the boiling point, the above equation reads,

$$T_x = \frac{(p_xv_x - C)m}{2}$$

C being a constant, individual for each liquid; being taken at 8.7 for water and m at 18 the last equation yields

$$T_x = \frac{m}{1.49}(p_x v_x - 8.7) = 12.1(p_x v_x - 8.7).$$

Since we calculate from tables of properties of saturated vapor of water that *pvat* 273° absolute amounts to 31 calories per kilogram the above equation for T_x gives

$$12.1\ (31\text{–}8.7) = 270°\ \text{absolute}$$

at 313 degrees at which *pv* is 34.6 cals. we find

$$12.1\ (34.6\text{–}8.7) = 313.3°\ \text{absolute.}$$

At 473 degrees absolute *pv* is equal 47.9 calories and

$$12.1\ (47.9\text{–}8.7) = 473.5°\ \text{absolute.}$$

Similar agreement is found for other vapors by inserting the correct valve for constant as long as no psolymerisation in the liquid takes place.

(1) *Molecular state of water vapor;* (2) *Vapor pressure depression equation for dilute aqueous solutions:* James Kendall.

Size and behavior of suspended smoke particles: R. E. Wilson.

Influence exerted by antagonistic electrolytes on the electrical resistance and permeability of emulsin membranes: G. H. A. Clowes.

The exact determination of molecular weights by the boiling point method: E. M. Washburn.

Solubility of strontium nitrate in anhydrous alcohol in alcohol containing small per cent. of water: C. W. Foulk.

(1) *Influence of the age of ferric arsenate on its peptization;* (2) *Syneresis of silicic acids gels:* H. N. Holmes.

A study of the lowering of vapor pressure of water produced by absorbed KCl: B. F. Lovelace, J. C. W. Frazer, V. B. Sease.

A study of the lowering of vapor pressure of water produced by absorbed mannite: J. C. W. Fraser, B. F. Lovelace, T. H. Rogers.

The volume and surface of the pores in charcoal and the compression of adsorbed substances: W. D. Harkins and D. T. Ewing.

An electromagnetic and valence hypothesis of heterogeneous equilibrium in adsorption: W. D. Harkins.

DIVISION OF WATER, SEWERAGE AND SANITATION

Robert Spurr Weston, *Chairman*

W. W. Skinner, *Secretary*

Determination of bromid in mineral waters and brines: W. W. Skinner and W. F. Baughman. Colorimetric methods for the determination of bromin give satisfactory results only when small quantities of bromin are to be determined. The method proposed for the determination of bromids in the presence of chlorids is the oxidation of the bromids and removal of the liberated bromid by steam distillation or by aspiration. The method depends upon the use of chromic acid for oxidation of the bromid. Chromic acid in concentrated solution liberates bromin from bromids quantitatively at room temperature and the bromin may be removed by aspiration. It liberates only a trace of chlorin from chlorids, forming probably chromic chlorid which remains in solution. When chromic acid acts on a solution of chlorids and bromids, some chlor-bromid is formed which is removed with the bromin by aspiration. The liberated bromin and the chlorin in the first aspiration is collected in a solution of sodium sulphite and sodium carbonate, which is evaporated to dryness and again submitted to the treatment with chromic acid and aspirated the second time. The double aspiration gives very accurate results.

Certain war gases and health: Charles Baskerville. Evidence has been collected from all the chlorine producing plants and many works and arsenals where chlorine was used. Preponderating evidence favors the conclusion that chlorine exerts a preventative influence against influenza. The evidence is not conclusive, however, as contrary data were obtained from some plants. The contradictions may possibly be harmonized on the basis of concentration, the more dilute up to limits the more effective. Small amounts of bromine in the air appear to prevent influenza completely.

Charles L. Parsons,
Secretary

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